Sightings of marine mammals in New Zealand waters by government fisheries observers

Technical report prepared for Department of Conservation (Project INT2022-06)

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Cover Notes

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EXECUTIVE SUMMARY

The Department of Conservation administers the New Zealand Marine Mammal Database, which contains sightings of marine mammals that are reported by the public, researchers, and permit holders for marine mammal viewing, and also contains records of marine mammal strandings. Data in this database may be used to monitor marine mammal populations and to provide information of species distributions.

At-sea sightings of marine mammals are recorded by government fisheries observers on-board commercial fishing vessels, as part of two main programmes started in 2009. One programme is aimed at monitoring groups of marine mammals in inshore fisheries, with frequent counts of different pods recorded on handheld electronic devices (Nomad devices). The other programme is aimed at monitoring the abundance of seabirds around fishing vessels, and these counts are entered on paper forms; however, ad-hoc sightings of marine mammals have also been recorded. In addition, marine mammals caught as bycatch in commercial fisheries have also been recorded on non-fish bycatch forms since 1990.

To date, these data from fisheries observers have not been integrated into the New Zealand Marine Mammal Database, prompting the current project. Its overall aim was to prepare these data for inclusion in the New Zealand Marine Mammals Database, including the development of an online application that allows data to be queried and visualised.

The final dataset of sightings from observers included 13 815 unique sighting events of a total of 105 817 animals, of 32 taxa. The latter included 26 species or sub-species, while the remaining the remaining taxa were groups of species. Summarising these data, there were 9 812 sightings of 29 553 individual pinnipeds (4 species), 3 591 sightings of 75 182 individual dolphins (13 species and sub-species), and 412 sightings of 1 082 individual whales (9 species).

At the time of this project, there were 21 507 sightings of marine mammals in the New Zealand Marine Mammal Database, representing 57 different taxa. Sightings from government fisheries observers, therefore, represent a significant addition to the database.

1. INTRODUCTION

A total of 57 species of marine mammals are considered to frequent New Zealand waters, including endemic, migratory, and vagrant species (Baker et al., 2019), and including almost half of the world's cetacean species. Assessment of the conservation status of New Zealand marine mammals classified ten species as "At risk" or "Threatened", with insufficient data for 30 species classifying them as "Data deficient", based on them being rare or inconspicuous.

In an effort to improve knowledge of cetaceans and pinnipeds in New Zealand, the Department of Conservation established the New Zealand Marine Mammal Database to centralise all sightings of cetaceans and pinnipeds, reported by the public (e.g., via a website; https://www.doc.govt.nz/marine-mammal-sighting-form), by researchers, permit holders for marine mammal viewing, historical sightings, and records of marine mammal strandings. At the time of this project, the database included 21 507 sightings of marine mammals across 57 different taxa.

One source of data that had not been integrated into the database was the collection of sightings from government fisheries observers on-board commercial fishing vessels, and records of incidental captures of marine mammals in fisheries. Government observers on board fishing vessels record sightings of marine mammals at sea, either in an ad-hoc way (as part of a programme to track the abundance of seabirds around fishing vessels), or as part of marine mammal surveys. For the latter, pods of animals are tracked over time in inshore fisheries, and data are recorded on electronic handheld devices (Nomad devices). In addition, observers also record any incidental capture of non-fish species on non-fish bycatch forms, and these data include a number of marine mammals.

The aim of this project was to prepare these fisheries observer data for inclusion in the New Zealand Marine Mammal Database. In this project, all available observers data of sightings and captures of marine mammals were collated into a single dataset. This dataset underwent thorough curation, including correction of errors, completion of missing information, and reformatting to ensure efficient integration into the New Zealand Marine Mammal Database. The project also included the development of an online application (in R and Shiny) to facilitate exploration and review of the sightings data. This report describes the data preparation, and includes a brief summary of the data to be integrated into the database.

2. METHODS

Data of marine mammals sightings from government observers on-board commercial fishing vessels were included from three main sources: records of counts of seabirds that included marine mammal sightings, surveys of marine mammal activity recorded on handheld Nomad devices, and records of incidental captures of marine mammals. Early records are available from 1990 onwards, but were generally scarce before 2007. The data were incomplete for 2023.

Government fisheries observers have been recording the abundance of seabirds at fishing vessels since 2009 (Richard et al., 2011), and also include marine mammal sightings in these records. For this reporting programme, counts by observers are generally carried out on the first tow of the day, and the data are recorded on paper forms by species; when the observer is unable to confirm the species, data are recorded by species group.

Initially, the paper forms for the period between 2009 and 2011 were double-entered digitally (by Dragonfly Data Science) to minimise data entry errors. Since then, the data have been manually entered by Department of Conservation staff. These data were were provided for this project as a set of MS Excel spreadsheets.

Sightings data are also recorded in another observer programme, aimed at monitoring groups of marine mammals in inshore fisheries. Instead of recording single counts (as recorded for seabirds), individuals or groups are monitored continuously. For this data collection, observers record the start and end time of the period during which the animals are observed, and also their activity. The data are entered on a handheld electronic Nomad device, which generally provides the location coordinates automatically. The use of these devices formalises the data entry and, therefore, reduces the number of typing mistakes and misinterpretations. The Nomad data were provided by Department of Conservation.

The preparation of both seabird counts and Nomad data included the correction of errors and typing mistakes, and also the standardising of species codes, dates, and times (see details in Richard et al. (2011) and Richard et al. (2020)). For the current project, only the counts of marine mammals were included, discarding the data on seabirds and other animals, such as turtles and sharks.

The processing of the marine mammal count data was simplified from the previous approach for seabird count data by Richard et al. (2011) and Richard et al. (2020), because the focus of the present project was on the presence of marine mammals. In contrast, the earlier preparation of seabird count data also included absences. The main difference between this project and the seabird count data was that the degree of visibility was not considered here. In addition, counts made in poor conditions were not removed, because only counts taken when marine mammals were present were considered.

Another change in the current data preparation was the standardisation of frequent counts. To minimise multiple counts of the same animals when counts were frequent, the maximum count within two-hour periods by species and fishing trip was selected, while ensuring that there were at least two hours between subsequent selected counts; the remaining count data were discarded.

The count data included the observed trip and fishing event numbers which, after corrections for typing mistakes, allowed each record to be linked to details on the fishing event stored in the Centralised Observer Database (COD) (Sanders & Fisher, 2022) and in the Fisheries New Zealand catch-effort database "warehou" (Ministry of Fisheries Research Data and Reporting Group, 2010). In particular, the geographic coordinates of the count record (as longitude and latitude), fishing method, and target species, and date and time, completed the count data.

When the coordinates were missing, they were imputed from the previous and next locations, weighted by the time difference between them. If an event with missing coordinates was first on the fishing trip, i.e., before any known coordinates, the first

known coordinates were used. Conversely, the last known coordinates were used if the event with missing coordinates was the last event on the trip.

To facilitate the exploration and review of the sightings data, an online application was developed in R and Shiny. The application consists of an interactive map showing the location of each sighting, and the details associated with the sighting. The latter included the number of animals seen, the species, date and time, fishing method and fishing target.

3. RESULTS

The final dataset of marine mammal sightings included 13 815 unique sighting events and a total of 105 817 animals. These sightings were of 32 taxa, which included 26 species or sub-species; the remaining taxa were groups of species (Table 1, and Appendix A for scientific names). There were 9 812 sightings of 29 553 individual pinnipeds (4 species), 3 591 sightings of 75 182 individual dolphins (13 species and sub-species), and 412 sightings of 1 082 individual whales (9 species). The majority (56%) of sightings were of New Zealand fur seal, followed by New Zealand sea lion (12%), common dolphin (11%), Hector's dolphin (5%), and dusky dolphin (3%). These species combined represented almost 90% of all sightings.

Marine mammal sightings from the seabird count programme represented approximately 62% of all sightings, with data from incidental captures and Nomad devices representing 28% and 12% of the data, respectively. These proportions varied between pinnipeds and cetaceans; pinnipeds were less represented in the Nomad data, with only 3% of the pinniped sightings originating from the Nomad programme compared with around 25% of the cetaceans sightings (Figure 1). In contrast, there was a higher proportion of pinniped records from the reported incidental captures, with 38% of records of pinnipeds compared with 5% of cetaceans.

Across all taxa, there was a peak in the number of records in 2009 (Figure 2). This peak corresponded to the start of the seabird counts and Nomad programmes, and to a large increase in observers in inshore fisheries to monitor Hector's and Māui dolphins (Ramm, 2010). The annual number of records subsequently decreased, but remained approximately constant after 2011.

When observers cannot identify a species in a sighting confidently, they use one of the codes that describe groups of similar taxa in lieu of specific codes. There were 1087 sightings with these types of code, representing 7.9% of all sightings across the three main groupings. Nevertheless, the rate of non-specific sightings varied across groupings, and was the lowest among pinnipeds, at 4.1%. In contrast, non-specific sightings formed the majority of records among the whale taxa (Figure 2), as 269 sightings out of the 412 whale sightings were non-specific, representing 65.3%. Among dolphin sightings, the rate was 11.4%.

Table 1: Summary of the complete dataset of sightings and incidental captures of marine mammals recorded by government fisheries observers in New Zealand waters. Sightings data covered the period January 2009 to June 2023, and capture data the period March 1990 to February 2023. See Appendix Table A - 1 for the scientific names.

Grouping	Species or species group	No. of events	No. of animals
Pinnipeds	New Zealand fur seal	7 675	22 127
	New Zealand sea lion	1 723	6 168
	Leopard seal	6	11
	Elephant seal	1	1
	Seals and sea lions (unspecified)	407	1 246
	Total	9 812	29 553
Dolphins	Common dolphin	1 523	38 635
	Dusky dolphin	424	19 769
	Hector's dolphin	744	4 319
	Bottlenose dolphin	209	2 581
	Long-finned pilot whale	122	1 492
	Orca	144	774
	False killer whale	4	47
	Short-finned pilot whale	1	25
	Striped dolphin	1	15
	Maui dolphin	3	6
	Spinner dolphin	1	5
	Long-beaked common dolphin	3	3
	Risso's dolphin	1	1
	Dolphins (unspecified)	347	7 037
	Dolphins and toothed whales (unspecified)	64	473
	Total	3 591	75 182
Whales	Southern right whale	30	208
	Humpback whale	49	112
	Sperm whale	32	74
	Minke whale	9	33
	Fin whale	7	18
	Bryde's whale	8	18
	Sei whale	5	10
	Porpoise	2	7
	Blue whale	1	1
	Whales (unspecified)	242	549
	Baleen whales (unspecified)	21	39
	Beaked whales (unspecified)	6	13
	Total	412	1 082
Total	Total	13 815	105 817

For data recorded by fisheries observers, the location of the sightings was restricted to areas where fishing occurred (Figure 3; see maps of fishing effort by fishery at https://protectedspeciescaptures.nz/). Nonetheless, the sightings covered a significant proportion of New Zealand's Exclusive Economic Zone. Highly productive areas, where

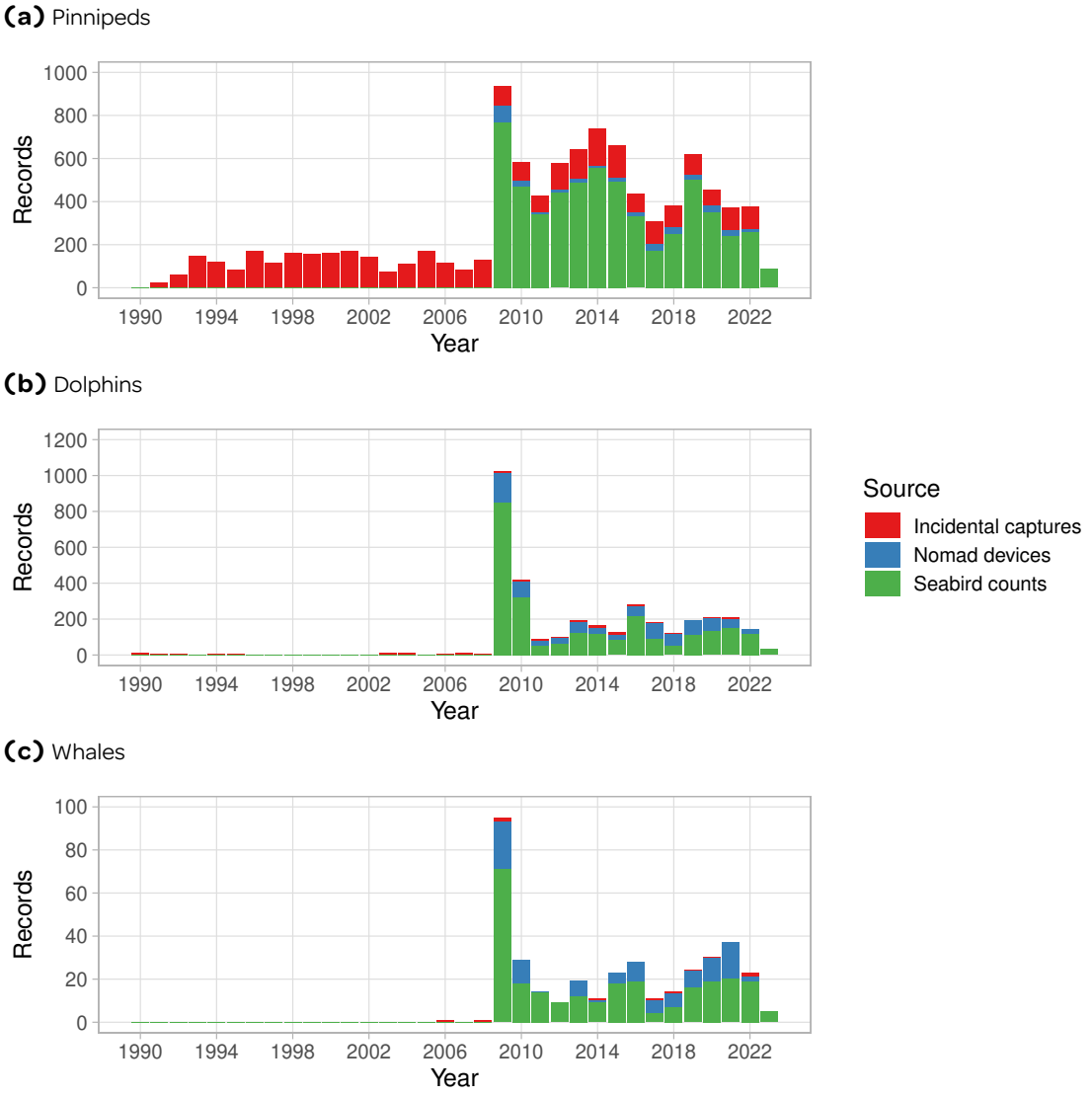

Figure 1: Number of records of marine mammal sightings by main grouping, reported by fisheries observers on-board commercial fishing vessels. Data are shown by year and source. Data sources were incidental capture records, sightings recorded on electronic (Nomad) devices, and sightings recorded during seabird counts. Data for 2023 were incomplete.

fishing effort is high, were particularly represented, such as the continental shelf breaks, especially around the Snares, Auckland, Campbell, and Bounty islands, and on the edge of the Stewart Snares shelf.

The sightings data showed different distribution patterns across taxa (see Figure 3 and Appendix B, Figures B.1 to B.3 for maps of sightings for individual taxa). Pinniped sightings, largely dominated by New Zealand fur seal, and were reported across most of the fishing areas, but were less common in northern North Island. Sightings of New Zealand sea lion were concentrated around Auckland and Campbell islands. Dolphin sightings were uncommon offshore and concentrated inshore around the entire New Zealand coastline. Common dolphin were sighted most frequently along the north

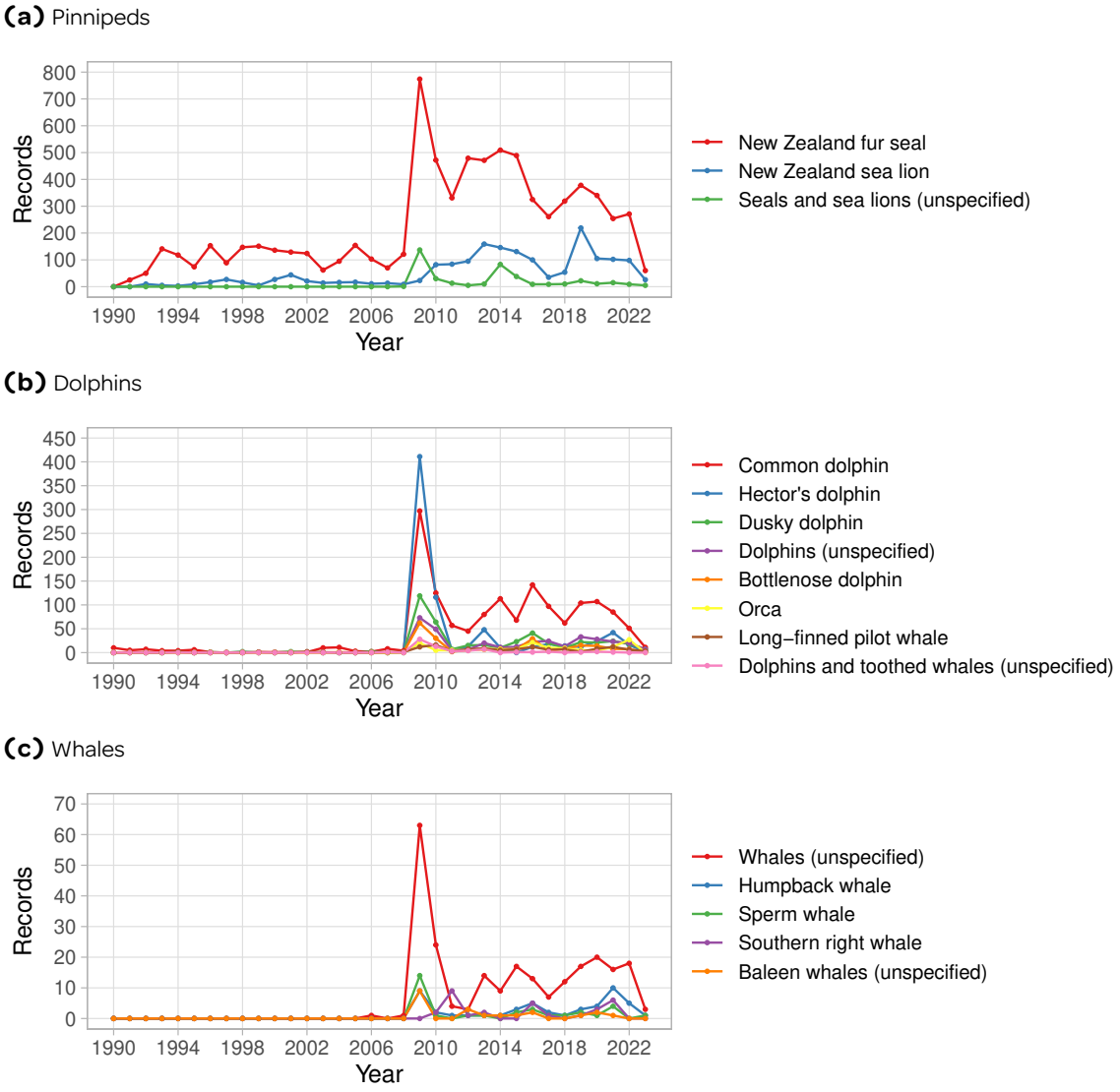

Figure 2: Number of records of marine mammal sightings by species or species group within main groupings, reported by fisheries observers on-board commercial fishing vessels. Data are shown by year, and only from 2007 for clarity. Data for 2023 were incomplete.

and west coast of North and South islands, whereas Hector's dolphin sightings were concentrated around Banks Peninsula; dusky dolphins sightings were scattered around South Island. Sightings of whales were comparatively less common and scattered within the entire fishing area, without discernible patterns.

The dataset of sighting records from government observers was reshaped to follow the schema used in the New Zealand Marine Mammal Database, so that these records can be added to the database. At the time of this report, there were 21 507 sightings of 57 different taxa of marine mammals recorded in the New Zealand Marine Mammal Database. In comparison, the dataset prepared in this study included 13 815 sightings of 32 taxa and, therefore, represents a significant addition to the New Zealand Marine

Mammal Database.

This project also developed an online application that allowed the query and interactive visualisation of the dataset prepared in this study (see screenshot in Figure 4). This online application is for internal use by Department of Conservation staff to check individual sightings, and include species identifications and metadata, allowing the correction of mistakes.

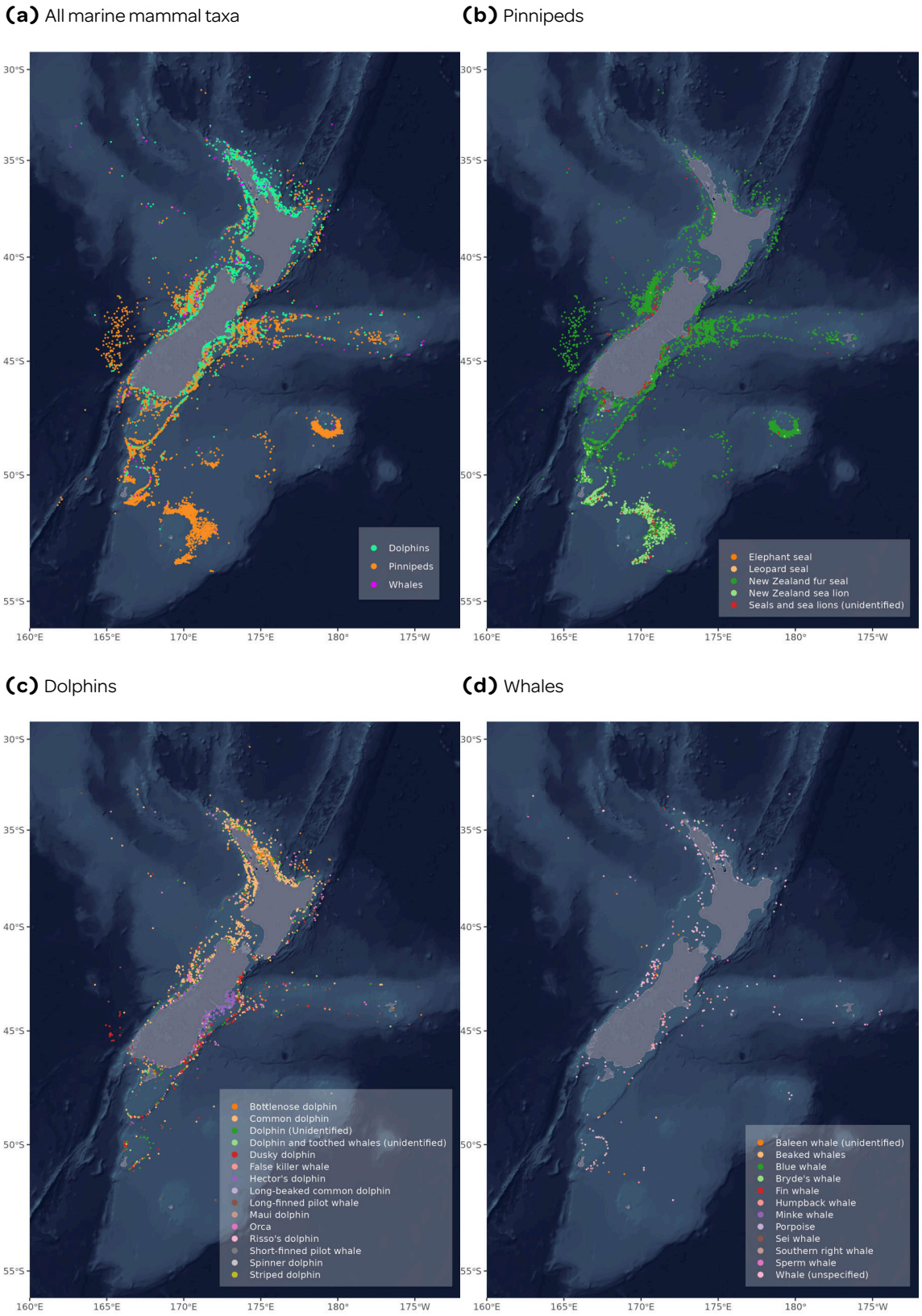

Figure 3: Distribution of the marine mammal sightings by main grouping (a), and by taxon for pinnipeds (b), dolphins (c) and whales (d).

Figure 4: Screenshot of the online application to visualise and review the sighting records of marine mammals by government fisheries observers on-board commercial fishing vessels in New Zealand waters.

4. DISCUSSION

The sightings of marine mammals by government fisheries observers represent an abundant and valuabe resource that reflects a significant addition to the New Zealand Marine Mammal Database. The dataset prepared in this study will increase the number of cetacean records by two third of the records that were held in the database. These additional data include records of three species that are new to the database.

Although the data are restricted to areas where fishing occurs, the sightings from fisheries observers cover a considerable area across New Zealand's Exclusive Economic Zone. As such, they provide a clear insight into the at-sea distribution of a number of marine mammal species. Nevertheless, the observer data were dominated by records of a small number of species, with almost 90% of the records reflecting five species of pinnipeds and dolphins; among these records, the majority of sightings were of New Zealand fur seal.

Sightings that were recorded using a generic identification of the animal and not an identification at the species or sub-species level, provide limited information, as they are difficult to consider in studies of at-sea distributions. Although the overall proportion of sightings with a generic identification was relatively low in the final dataset (less than 8%), this low level of identification was particularly limiting for whales; 65% of whale sightings were only identified at a generic level. Considering the limited current knowledge of the at-sea distribution of whales, improving identifications for this group of species, e.g., through additional observer training, would be valuable in ongoing data collections and future analyses.

Although these data provide insights into marine mammal distributions in New Zealand waters, there are several limitations to the use of these data. For example, the species identifications of sightings were not verified and rely on the correct identification by observers. In addition, the locations, date, and time of the sightings may also include errors. Although the current study made an effort to minimise these errors, the locations were generally obtained from databases on fishing effort, linked to the sighting record as closely as possible. The location of the start of the corresponding fishing event was generally used, but this time could potentially be hours apart from the time of the sighting. Finally, the current data were only based on presences and not absences, and observation effort is not included in this dataset.

In spite of these limitations, sightings data from fisheries observers remain a valuable source of information, improving our knowledge of the at-sea distribution and behaviour of marine mammals in New Zealand waters.

5. ACKNOWLEDGEMENTS

We are grateful to Mike Ogle and Hollie McGovern at the Department of Conservation for providing the data and for their comments on the various stages of the project.

These datasets would not have been possible without the work from government observers, and we acknowledge their long hours at sea collecting and recording these valuable data.

We are also grateful to the developers, maintainers, and contributors to the numerous open-source software and libraries that greatly facilitate our work every day, notably LaTeX, Emacs, Ubuntu, Git, Docker, Postgres, Leaflet, and R (including its packages data.table, sf, ggplot, and qs).

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6. REFERENCES

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APPENDIX A SCIENTIFIC NAMES

Table A-1: Scientific names of the marine mammal taxa recorded in the study dataset.

Common name	Scientific name
New Zealand fur seal	*Arctophoca australis forsteri*
New Zealand sea lion	*Phocarctos hookeri*
Leopard seal	*Hydrurga leptonyx*
Elephant seal	*Mirounga leonina*
Common dolphin	*Delphinus delphis*
Dusky dolphin	*Lagenorhynchus obscurus*
Hector's dolphin	*Cephalorhynchus hectori hectori*
Bottlenose dolphin	*Tursiops truncatus*
Long-finned pilot whale	*Globicephala melas*
Killer whale	*Orcinus orca*
False killer whale	*Pseudorca crassidens*
Short-finned pilot whale	*Globicephala macrorhynchus*
Striped dolphin	*Stenella coeruleoalba*
Māui dolphin	*Cephalorhynchus hectori maui*
Spinner dolphin	*Stenella longirostris*
Long-beaked common dolphin	*Delphinus capensis*
Risso's dolphin	*Grampus griseus*
Southern right whale	*Eubalaena australis*
Humpback whale	*Megaptera novaeangliae*
Sperm whale	*Physeter macrocephalus*
Minke whale	*Balaenoptera sp.*
Fin whale	*Balaenoptera physalus*
Sei whale	*Balaenoptera borealis*
Blue whale	*Balaenoptera musculus subsp.*

APPENDIX B MAPS BY TAXA

B.1 Pinnipeds

(a) New Zealand fur seal

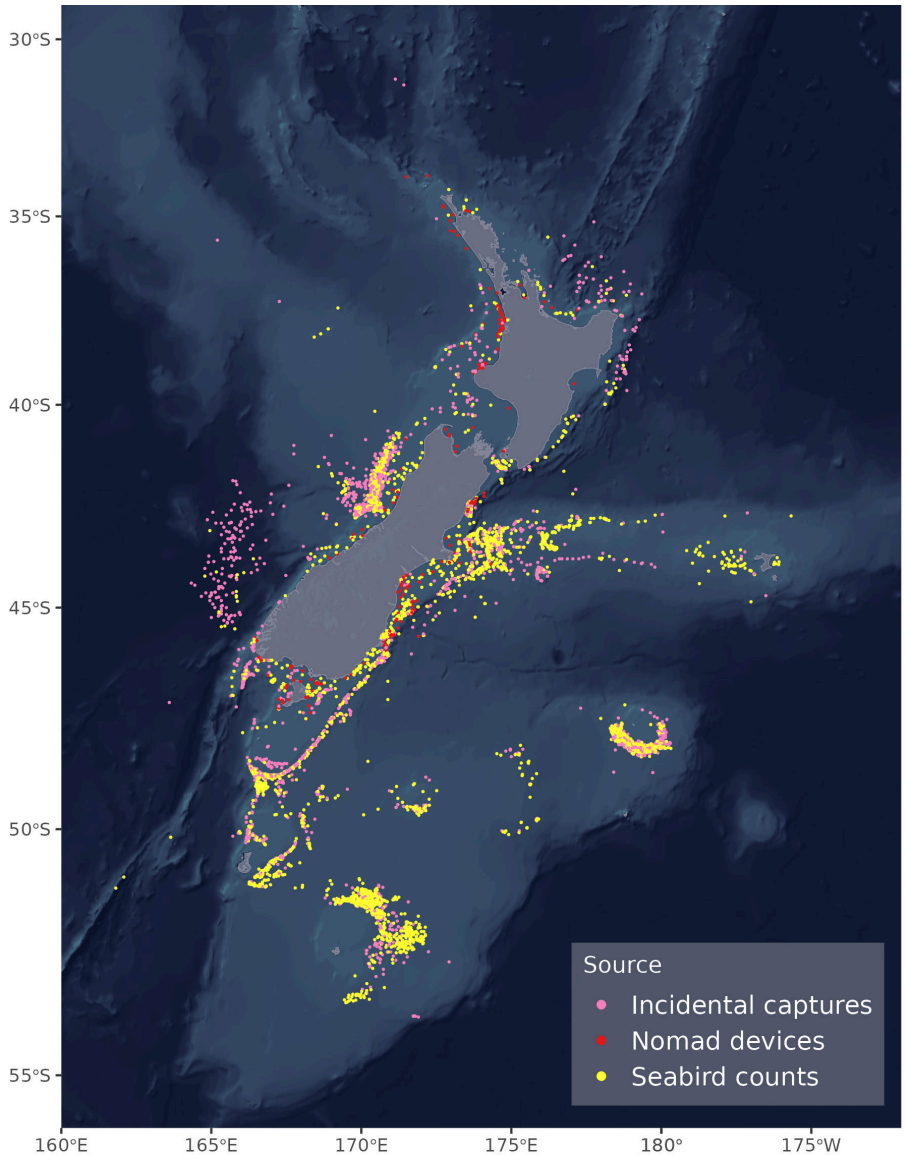
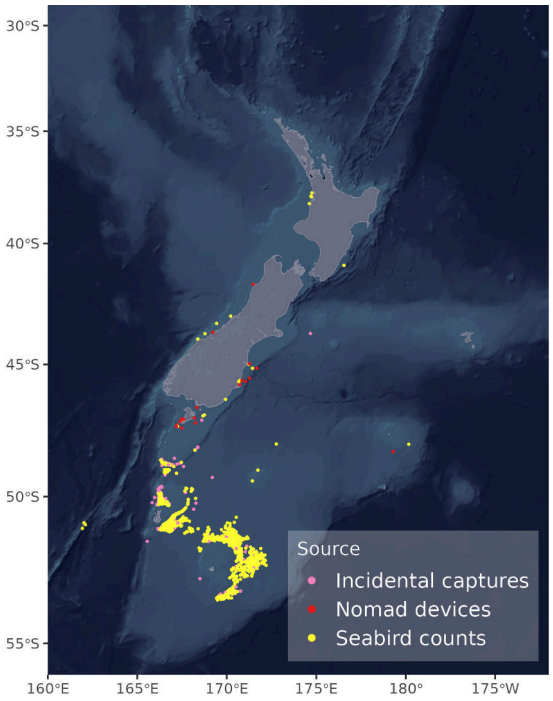
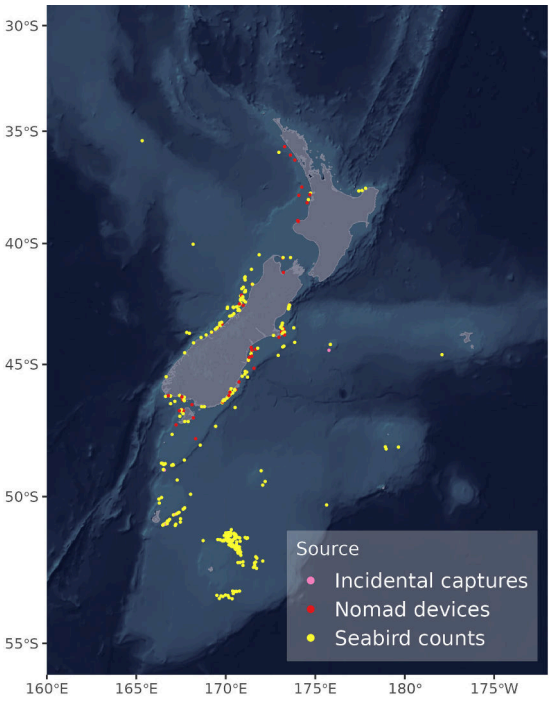


Figure B-1: Distribution of sighting records of pinniped taxa by government fisheries observers on-board commercial fishing vessels in New Zealand waters. Taxa are sorted in decreasing order of number of sightings records. Data sources were incidental capture records, sightings recorded on electronic (Nomad) devices, and sightings recorded during seabird counts. (*Continued on next page.*)

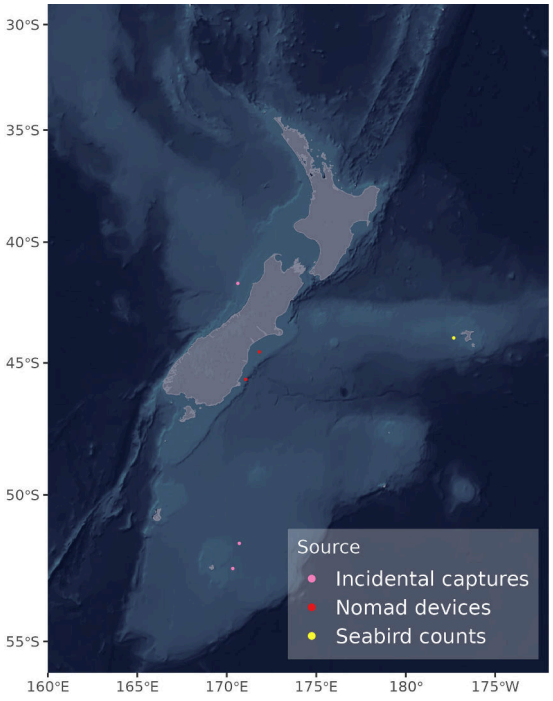
(b) New Zealand sea lion



(c) Seals and sea lions (unspecified)



(d) Leopard seal



(e) Elephant seal

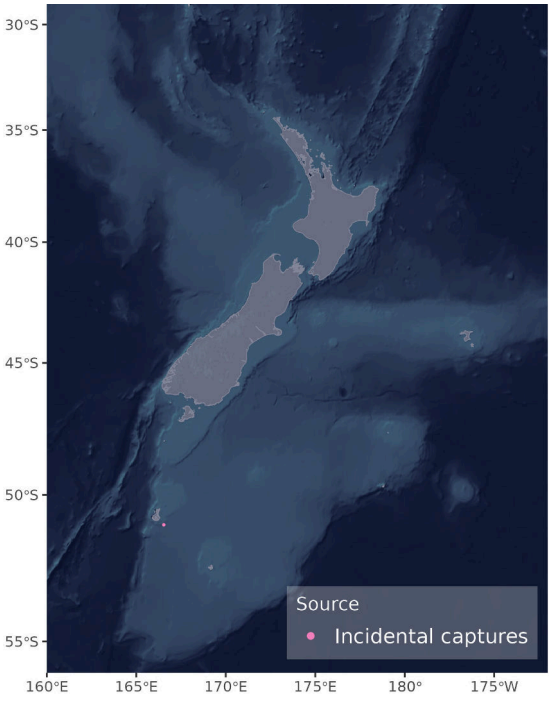
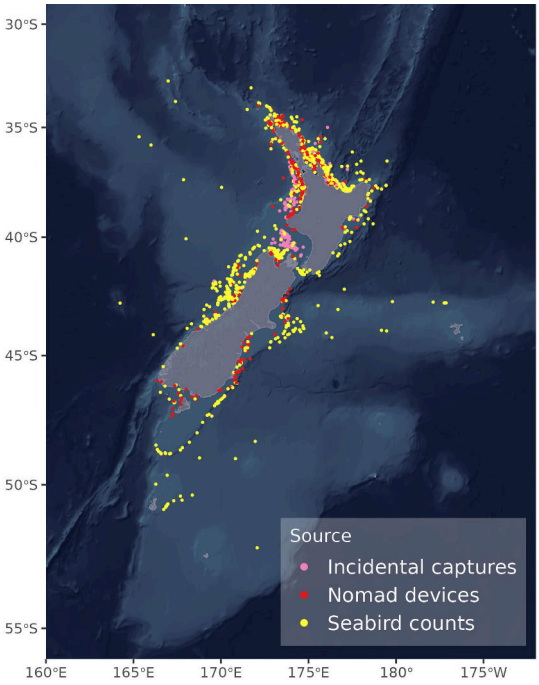


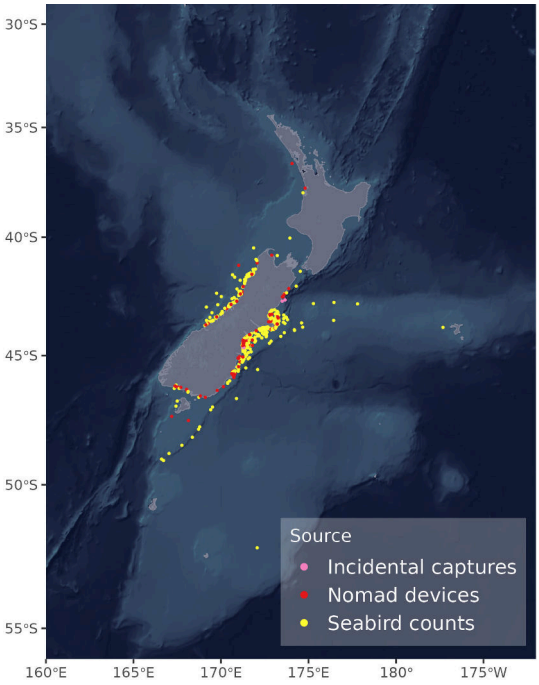
Figure B-1: (continued)

B.2 Dolphins

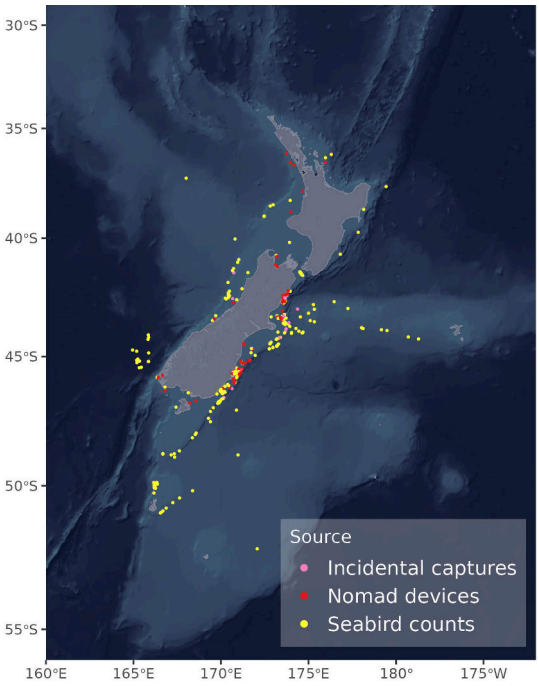
(a) Common dolphin



(b) Hector's dolphin



(c) Dusky dolphin



(d) Dolphins (unspecified)

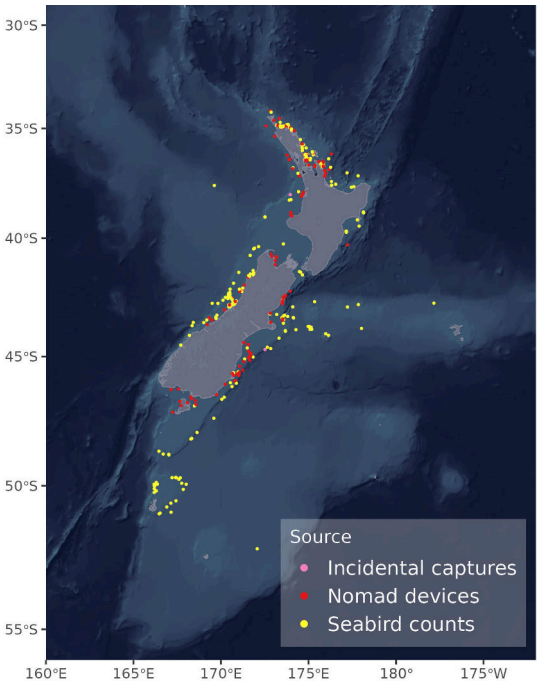
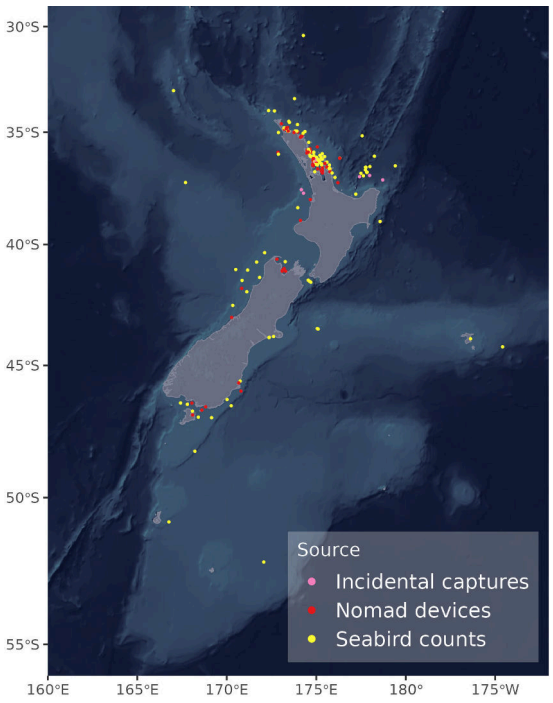
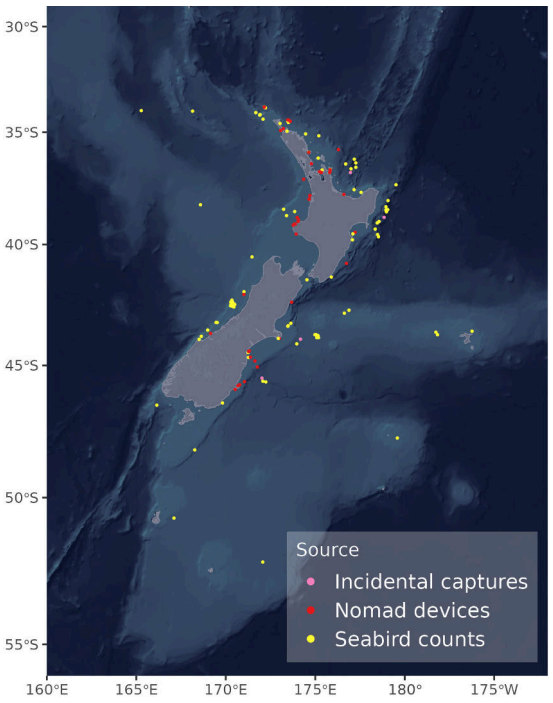


Figure B-2: Distribution of sighting records of dolphin taxa by government fisheries observers on-board commercial fishing vessels in New Zealand waters. Taxa are sorted in decreasing order of number of sightings records. Data sources were incidental capture records, sightings recorded on electronic (Nomad) devices, and sightings recorded during seabird counts. (*Continued on next page.*)

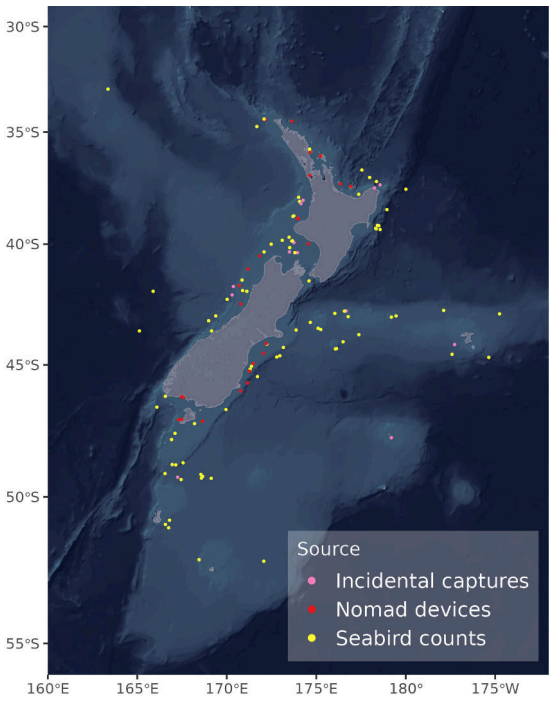
(e) Bottlenose dolphin



(f) Orca



(g) Long-finned pilot whale



(h) Dolphins and toothed whales (unspecified)

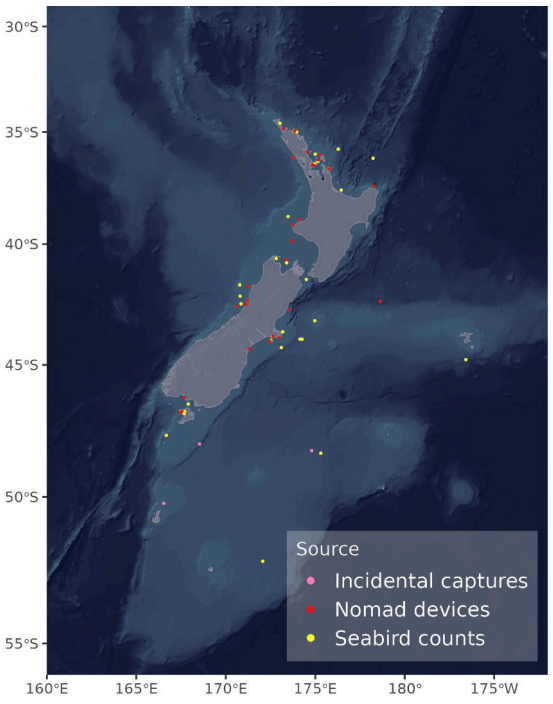


Figure B-2: (*continued*)

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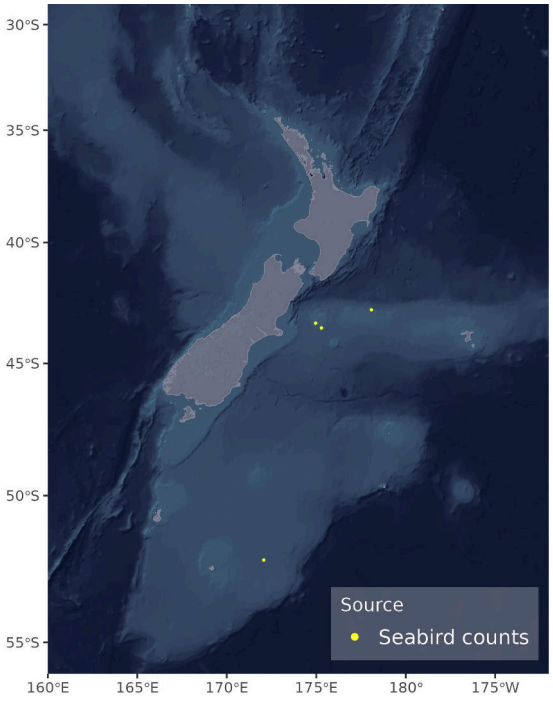
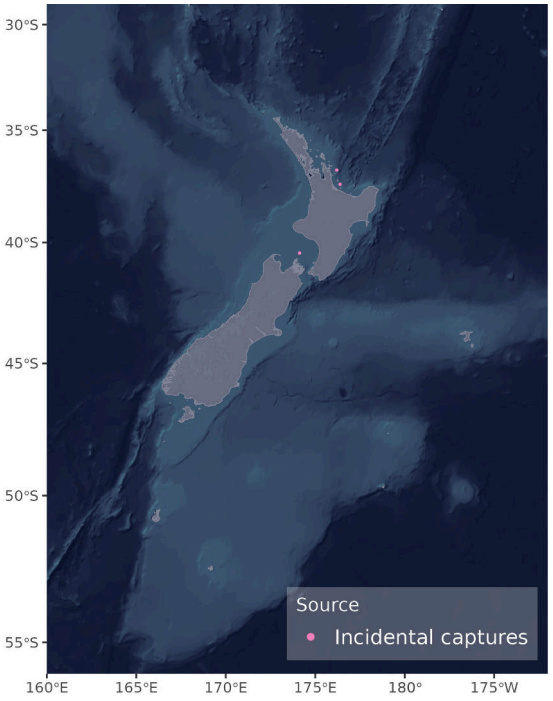
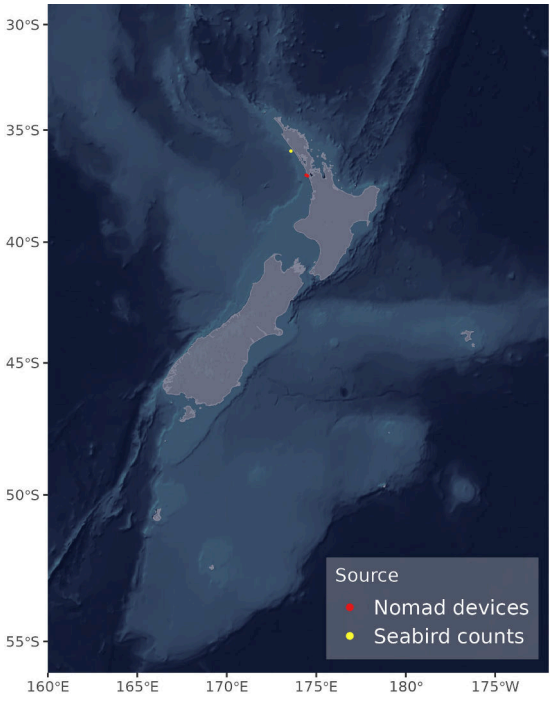
(i) False killer whale



(j) Long-beaked common dolphin



(k) Maui dolphin



(l) Risso's dolphin

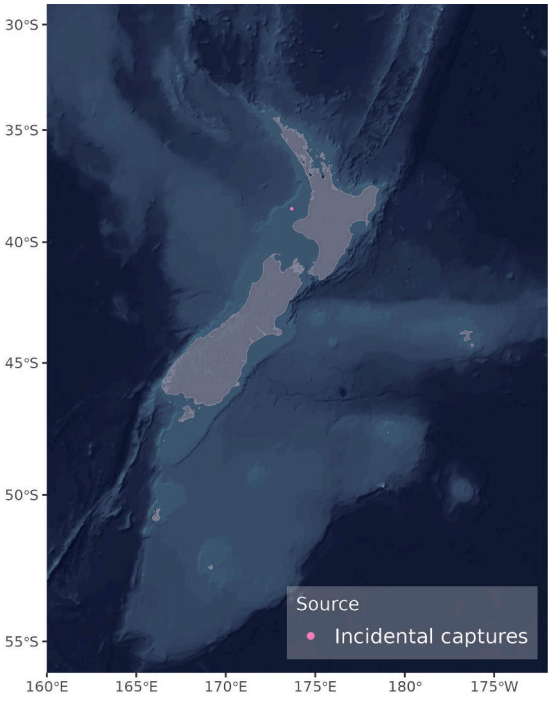
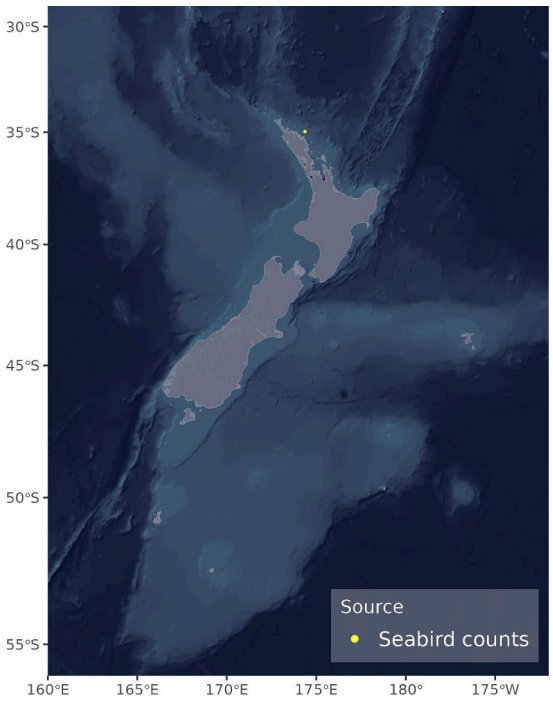


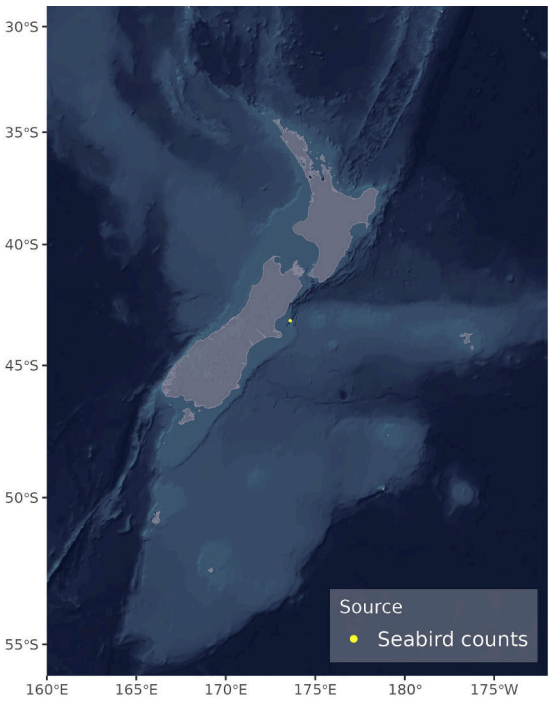
Figure B-2: (*continued*)

(*Continued on next page.*)

(m) Short-finned pilot whale



(n) Spinner dolphin



(o) Striped dolphin

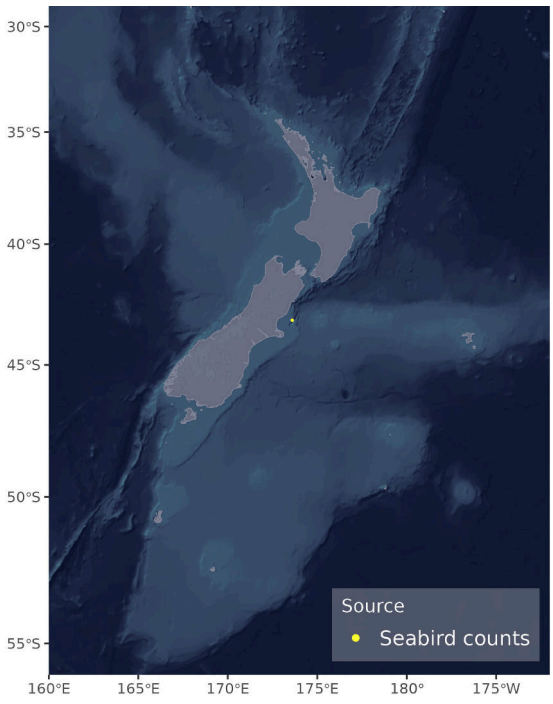
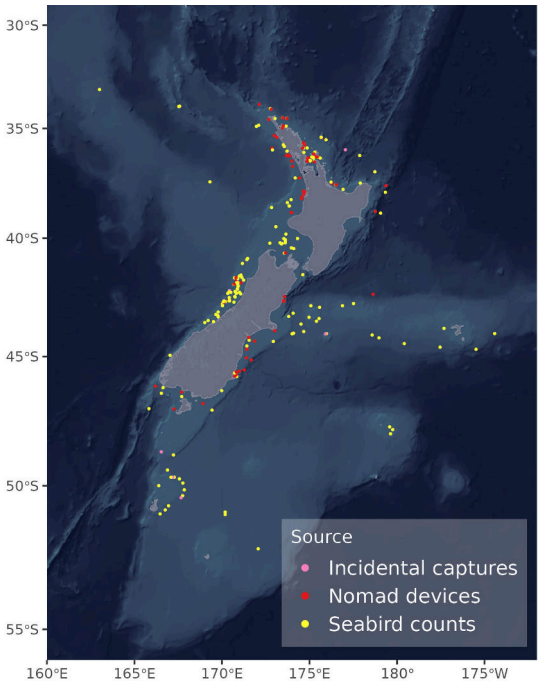


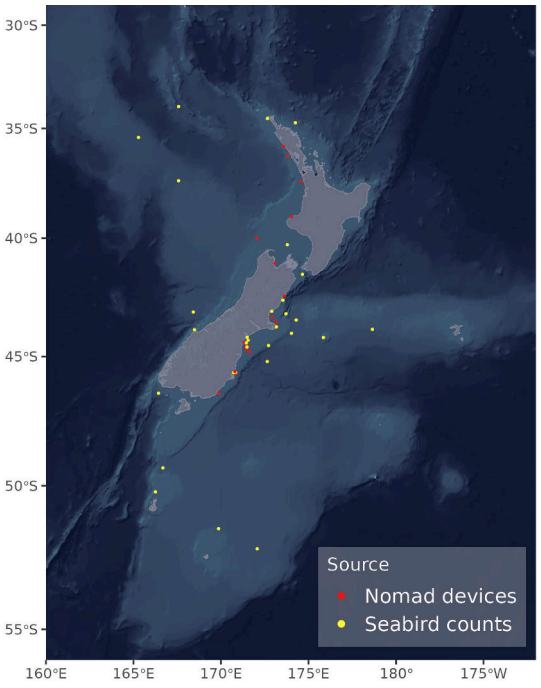
Figure B-2: (*continued*)

B.3 Whales

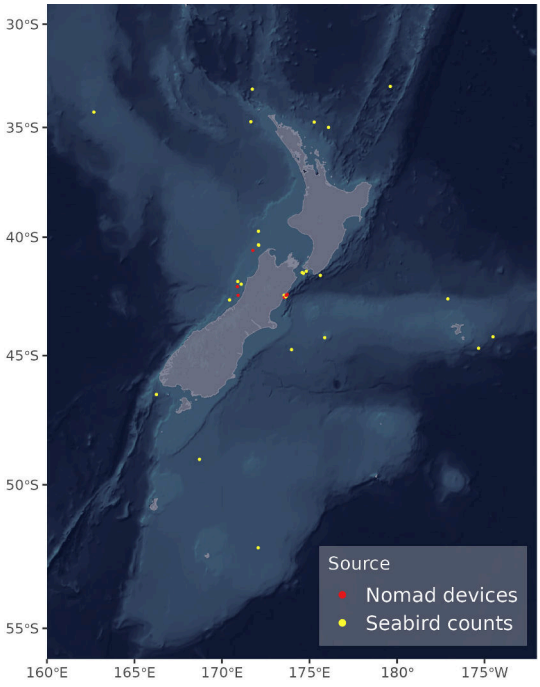
(a) Whales (unspecified)



(b) Humpback whale



(c) Sperm whale



(d) Southern right whale

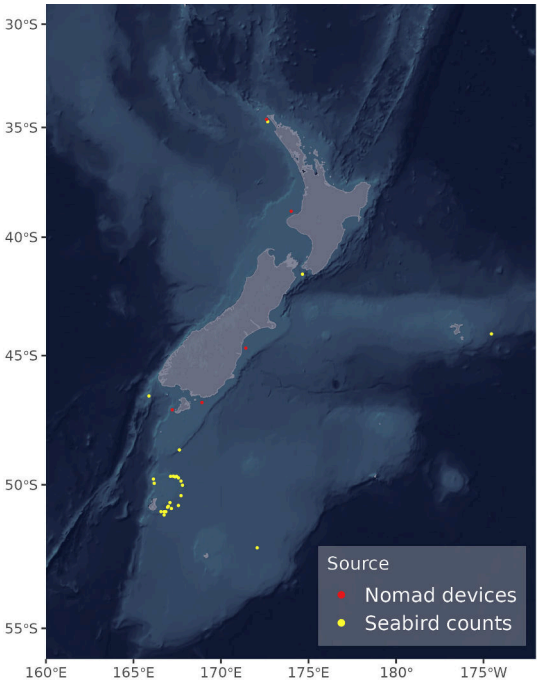
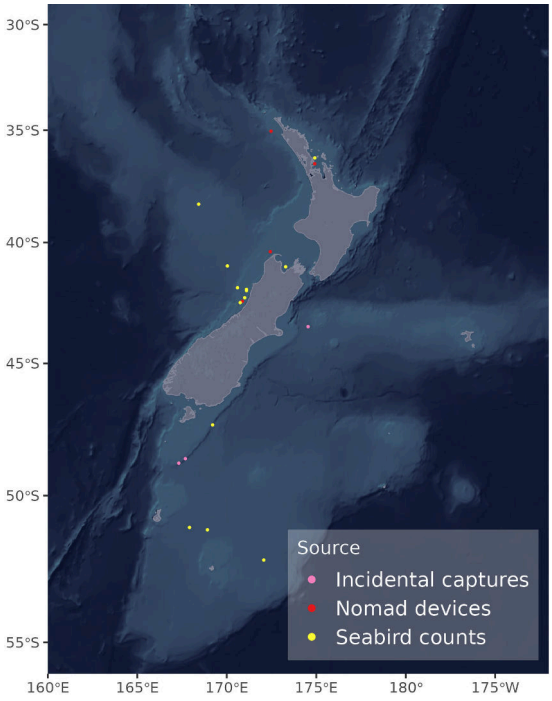
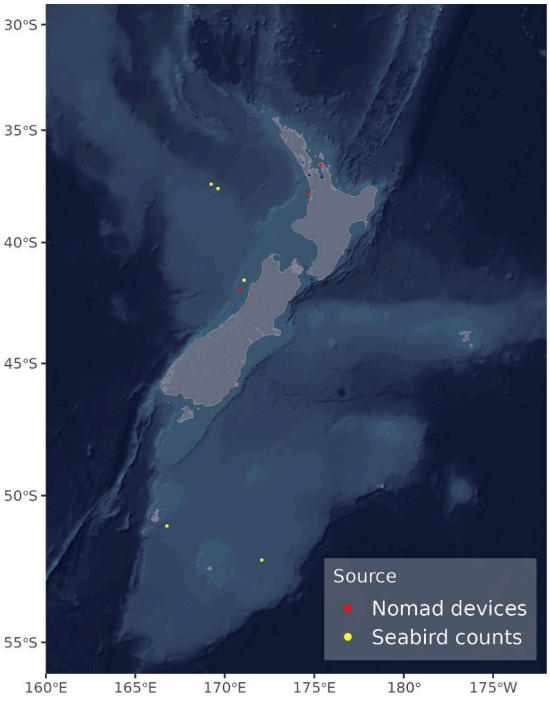


Figure B-3: Distribution of the sightings of whale taxa by government fisheries observers on-board commercial fishing vessels in New Zealand waters. Taxa are sorted in decreasing order of number of sightings records. Data sources were incidental capture records, sightings recorded on electronic (Nomad) devices, and sightings recorded during seabird counts. (*Continued on next page.*)

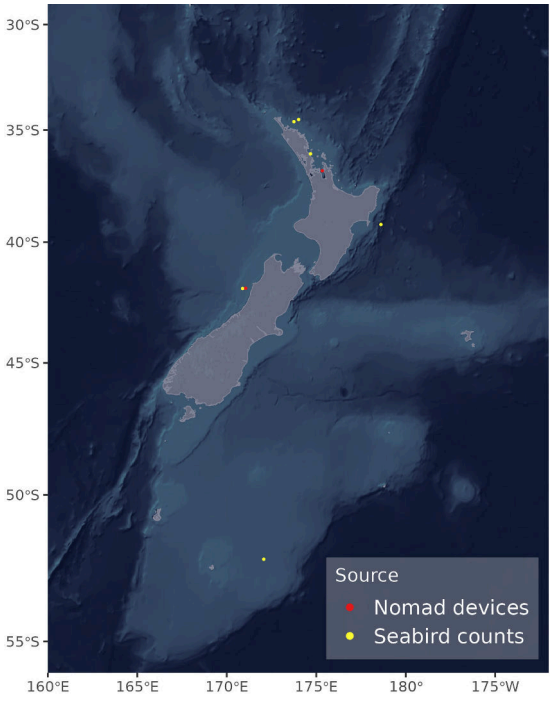
(e) Baleen whales (unspecified)



(f) Minke whale



(g) Bryde's whale



(h) Fin whale

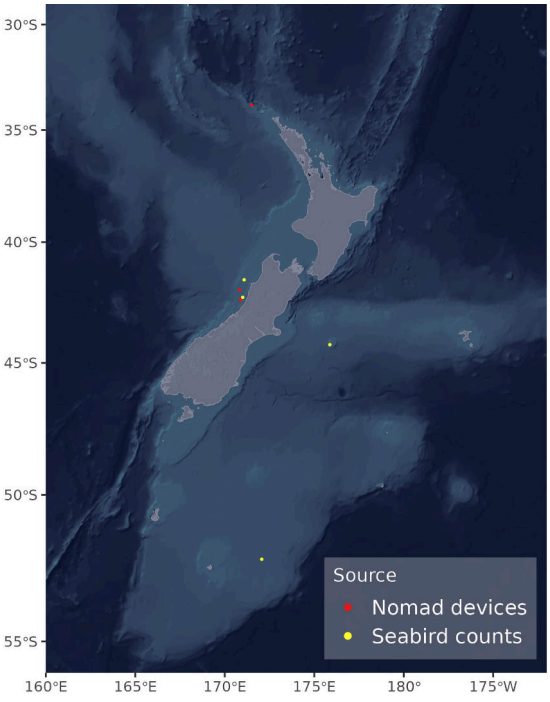
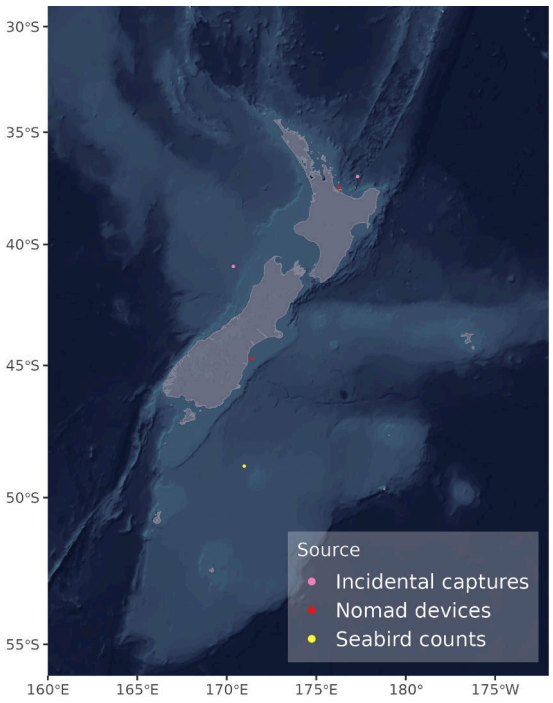


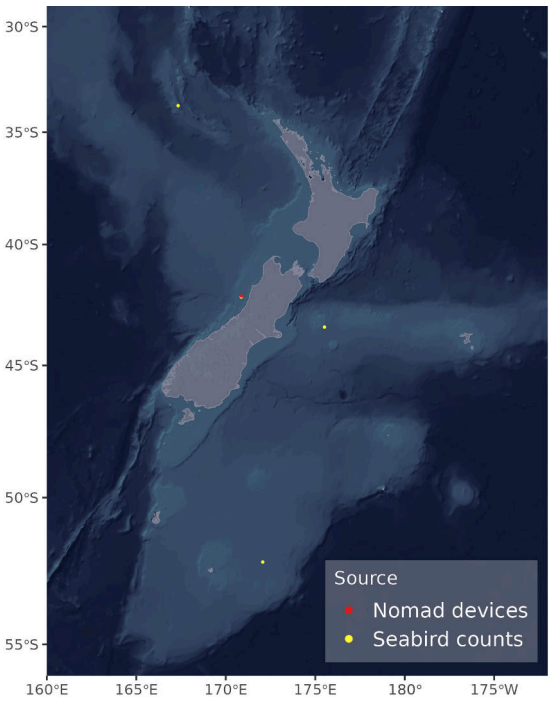
Figure B-3: (*continued*)

(*Continued on next page.*)

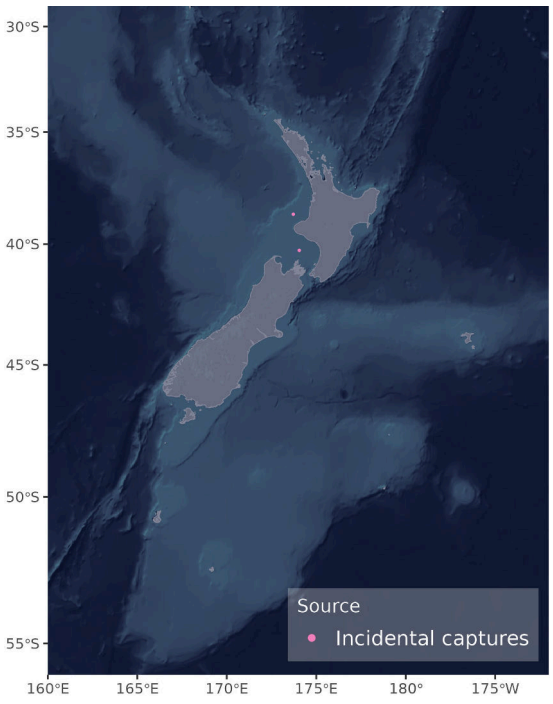
(i) Beaked whales (unspecified)



(j) Sei whale



(k) Porpoise



(l) Blue whale

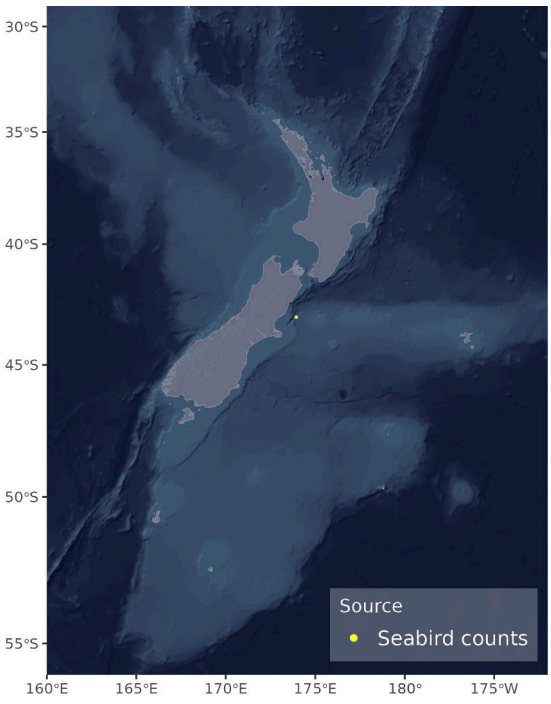


Figure B-3: (*continued*)